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Installation and Operating Instructions

DM330 Series
Magnetostrictive Level System

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Magnetostrictive Level System

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An ISO 9001 Certified Company

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Section 1

Section 1: Introduction

1.1 Product Description

The AMETEK Drexelbrook DM330 Series Magnetostrictive Level System is an integral assembly that measures linear motion or liquid level using magnetostrictive technology. A single level output is provided with configurable 4 and 20mA points in an intrinsically safe, standard two wired loop-powered configuration.

Unlike conventional level instruments the electronics are incorporated into the measuring probe and there is no external electronic housing. This design utilizes sophisticated Surface Mount Technology (SMT) integrated into a 5/8" diameter tube, reducing user's cost and offers greater options for insertion and mounting. The self-contained unit provides IP68 or Nema 4X protection in either rigid 316 stainless steel or flexible Polyvinylidene Fluoride (PVDF).

There are several reasons for using a flexible PVDF probe instead of a rigid stainless steel probe:

Limited Headroom: There may be limited space available above a tank, making it impossible to install a rigid probe without damaging the probe.

Chemical Compatibility: When an application is not compatible with 316 SS, then PVDF may be a good alternative.

Large Tanks: Since the 316 SS probe maximum length is 24 feet, PVDF can be substituted for larger tanks. PVDF probes are available in lengths up to 40 feet. Consult factory for longer lengths

Other standard options include a quick disconnect mini-connector or ¾" NPT conduit connection. An optional housing is available which includes terminal connectors and adjustors for zero & span.

A variety of floats and mounting accessories are available to fit nearly all applications. The sanitary stainless steel version features all welded and polished construction with 180 grit for food service or 240 grit, ground, and Polished finish for more stringent sanitary applications.

1.2 Terminology

Magnetostriction: A magnetic field produces small change in the physical dimension of ferromagnetic materials on the order of several parts per million in carbon steel and conversely, a physical deformation or stain (torsion) produces a change of magnetization in the material.

1.3 Technology

In a magnetostrictive level sensor a current pulse is sent down a wave guide made of a special nickel alloy wire designed to enhance magnetostrictive properties. A permanent magnet within a float is used to indicate the position or level being measured. The interaction of the current pulse with the magnetic field created by a float (with magnet) produces a torsional strain pulse that travels at approximately the speed of sound along the wire. A small induction pickup coil senses the strain pulse. The position of the float is determined with high precision by measuring the time between the launching of the current pulse and the arrival of the torsional strain pulse.

The magnetostrictive wire is linearized during manufacture and the speed of the torsional pulse is determined for the specific sensor. Inherently, magnetostrictive sensors have very high resolution and repeatability.

Magnetostrictive technology is excellent as well for applications where the dielectric constant is very low or is changing. The technology has been used quite successfully for the detection of leaks in underground storage tanks, for example. The measurement of a 0.1 gallon leak out of a 10,000 gallon tank over a period of one hour is the standard for EPA mandated leak detection.

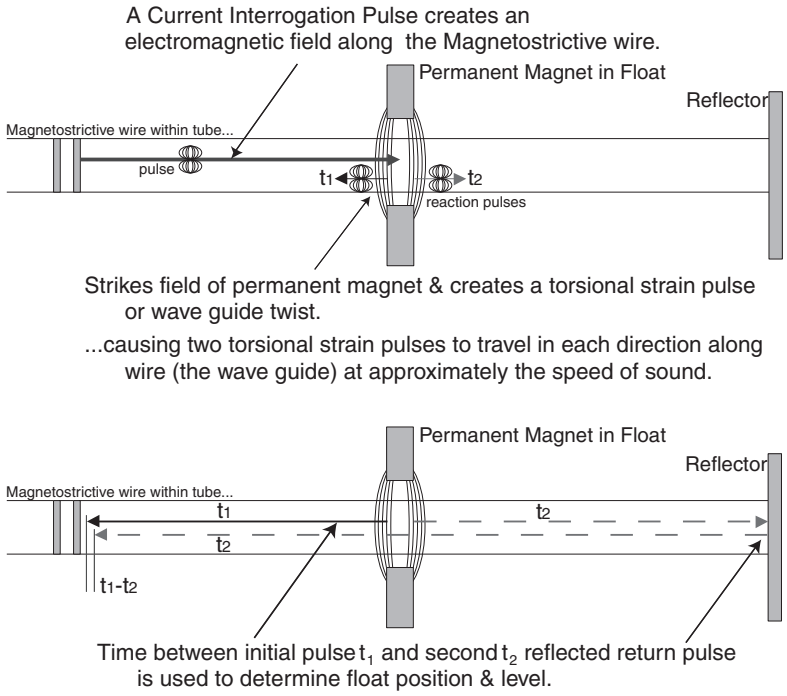

A Current Interrogation Pulse creates an
electromagnetic field along the Magnetostrictive wire.
Permanent Magnet in Float
Reflector
Magnetostrictive wire within tube...
pulse
t1
t2
reaction pulses
Strikes field of permanent magnet & creates a torsional strain pulse
or wave guide twist.
...causing two torsional strain pulses to travel in each direction along
wire (the wave guide) at approximately the speed of sound.
Permanent Magnet in Float
Reflector
Magnetostrictive wire within tube...
t1
t2
t2
t1-t2
Time between initial pulse t1 and second t2 reflected return pulse
is used to determine float position & level.

Figure 1-1
Magnetostrictive Theory

1.4 Model Numbering - Explosion-Proof

See section 6 for Explosion-Proof Approval Information

Magnetostrictive Level Measurement system
DM330

Probe Style / Material
X 316SS

Connector Style
D Dual 3/4" NPT - for both housing and vessel mounting
S Single 3/4" NPT - for housing mounting, vessel mtg. via compression fitting, flange or triclamp

Thread Mounting
E English Units - 3/4" NPT with Connector Style D or S

Overall Length
XXX (in inches only)

Output Signal
F1 1 Signal Output

Float 1 Type
XXX -- See Float in Chart below

Housing option
H Condulet with Zero & Span push-buttons

Special Mounting
Y Explosion proof Class I Div. 1, (FM & CSA)
Z Flame proof for Zone 1 (ATEX pending)

Special Mounting *(does not affect agency certification)*
CF Adjustable Compression Fitting (5/8" tube fitting to 3/4" NPT)
XX None

DM330 - □ - □ - □ - □□□-□□-□□□ - □ - □ □□

Float Kits Float Type selection includes Float, spacer and retaining clip

	Material	Shape	Diameter	Hight	S.G.	Max. Press.
PU0	Ureth.	Cylind	3.85"	2.75"	0.52	50psi
PN0	Nitrophyl	Round	2.02"	1.38"	0.4	300psi
PK0	PVDF	Oval	2.05"	2.40"	0.7	100psi
PE0	316SS	Oval	2.05"	2.7"	0.54	350psi
XXX	None					

YYY - Special Float / Float Kit ordered as a separate line item

1.5 Model Numbering - Intrinsically Safe

See section 6 for Intrinsically Safe Approval Information

Magnetostrictive Level Measurement system

DM330

Probe Style / Material

X	316SS
V	PVDF (Polyvinylidene Fluoride)
S	316SS 3A Sanitary 240 grit electropolished
F	316SS Food Grade 180 grit

Connector Style

M	Mini connector
D	Dual 3/4" NPT - for both housing and vessel mounting
S	Single 3/4" NPT - for housing mounting, vessel mtg. via compression fitting, flange or triclamp
R	Right Angle Connection - (1/2" NPT Electrical Connection)

Thread Mounting

E	English Units - 3/4" NPT with Connector Style D or S

Overall Length

XXX (in inches only, not to exceed 480 inches)

Output Signal

F1 1 Signal Output

Float 1 Type

XXX -- see Float/Weight Kits in Chart below

Housing option

H	Condulet with Zero & Span push-buttons
X	None

Special Mounting

C	C version [limited temp. range]
T	TriClamp with E-clip retainer
P	Triclamp with CIP perm. end plug [float non-removable]
W	Welded Flange Fitting
X	None

Mounting Size

20	2" Tri-clamp
25	2 1/2" Tri-clamp
30	3" Tri-clamp
40	4" Tri-clamp
CF	Adjustable Compression Fitting
XX	None

DM330 - □ - □ - □ - □□□-□□-□□□ - □ - □ - □□

Float Kits and Float / Weight Kits Float Type selection includes Float, spacer and retaining clip

	Material	Shape	Diameter	Hight	S.G.	Max. Press.
PS0	316SS	Oval	1.83"	2.94"	0.61	350psi (3A Approved)
PUX*	Ureth.	Cylind	3.85"	2.75"	0.52	50psi
PNX*	Nitrophyl	Round	2.02"	1.38"	0.4	300psi
PKX*	PVDF	Oval	2.05"	2.40"	0.7	100psi
PEX*	316SS	Oval	2.05"	2.7"	0.54	350psi
XXX	None					

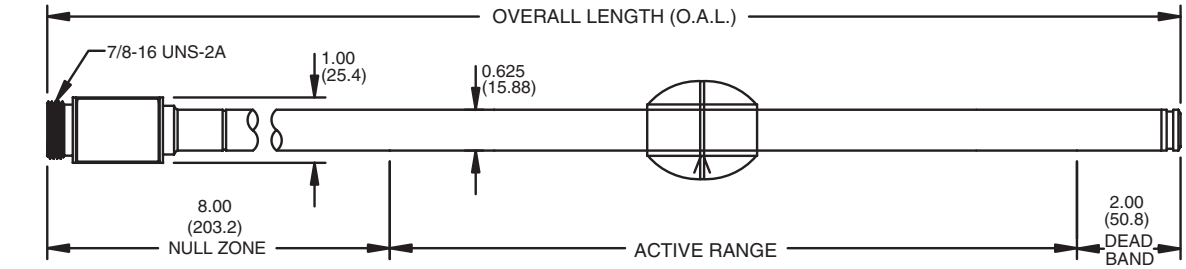
YYY - Special Float / Float Kit ordered as a separate line item

X* = Weight Kit

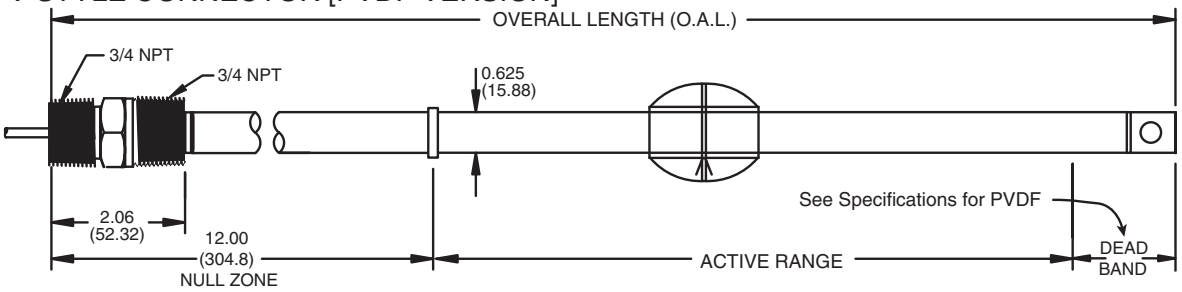
	Material	Shape	Diameter	Hight	
0	None	No weight kit on Stainless Steel probes (X, S, F, or H)			
1	316SS	Round	2"	5"	For PVDF Probe up to 144" long
2	316SS	Round	2"	7"	For PVDF Probe from 145" to 288" long
3	316SS	Round	2"	11"	For PVDF probe from 289" to 432" long
4	316SS	Round	2"	13"	For PVDF probe from 433" to 600" long

1.6 Probe Dimensions - Inches (mm)

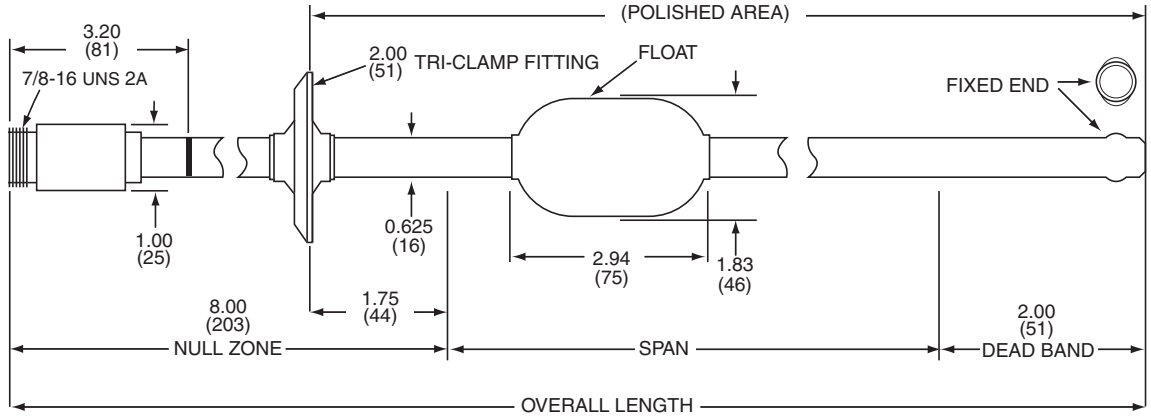
M STYLE CONNECTOR



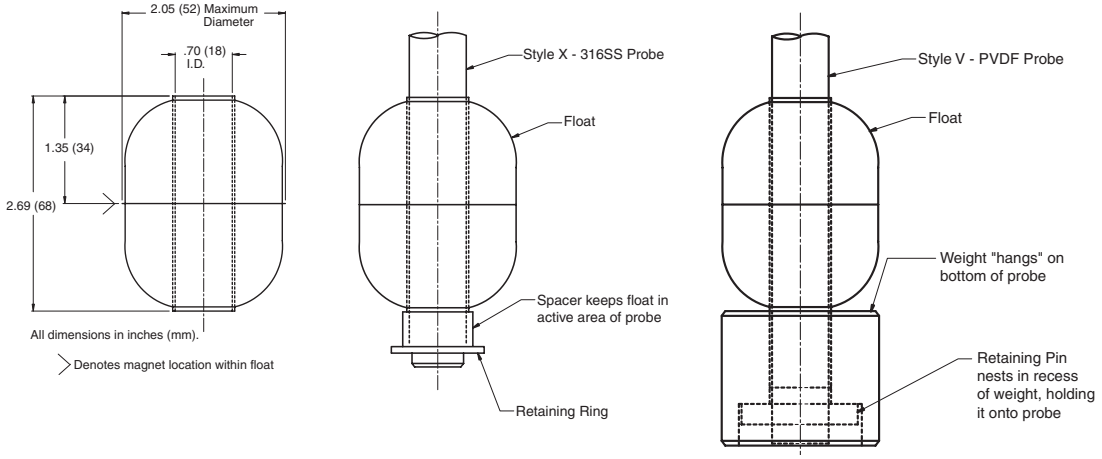
V STYLE CONNECTOR [PVDF VERSION]



1.7 Sanitary Probe Dimensions - Inches (mm)



1.8 Float Dimensions & Types - Inches (mm)



Section 2

Section 2: Installation

IMPORTANT
Be sure to read & understand all of the Installation Instructions before beginning the procedure!

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing materials. If there is any shortage or damage, report to the factory at 1-215-674-1234.

2.1.1 Storage

DM330 systems should be stored in their original shipping containers until ready for installation.

Special Caution:
DM330V – Flexible PVDF systems are shipped in a wooden crate approx. 4' x 4' (approx. 1m x 1m). The shipping crate protects the PVDF tubing from bending or damage. After inspection, this crate should be stored lying flat until ready for installation.

Do not remove the supporting tie wrap fasteners until ready for installation at the vessel top. Tie wraps should only be removed in the order indicated on the tie wrap tags.

2.1.1 Storage (Continued)

DO NOT remove from crate and store as shown below, the PDVF tubing may bend and become damaged under is own weight.

NOTICE

Damage that occurs in storage is not covered under manufacturers system warranty.

Please see section 2.5.3 for additional handling instructions.

2.2 Mounting Conditions

CAUTION

- **When installing probes, do not bend rigid probes, permanent damage may result.**

  Flexible PVDF probes are intended for coiling into a 40" (1m) loop. Bending beyond that diameter or repeated bending can cause permanent damage. Do NOT unwind until actually feeding into vessel!

  Longer rigid probes need to be supported at both ends while handling.

  Probes are sealed at the factory and have electronic circuits inside. Do not attempt to open probe or weld the tube.

- DM330 Series level system is designed for industrial applications, but should be mounted in a location as free as possible from vibration, corrosive atmospheres, or any possibility of mechanical damage.

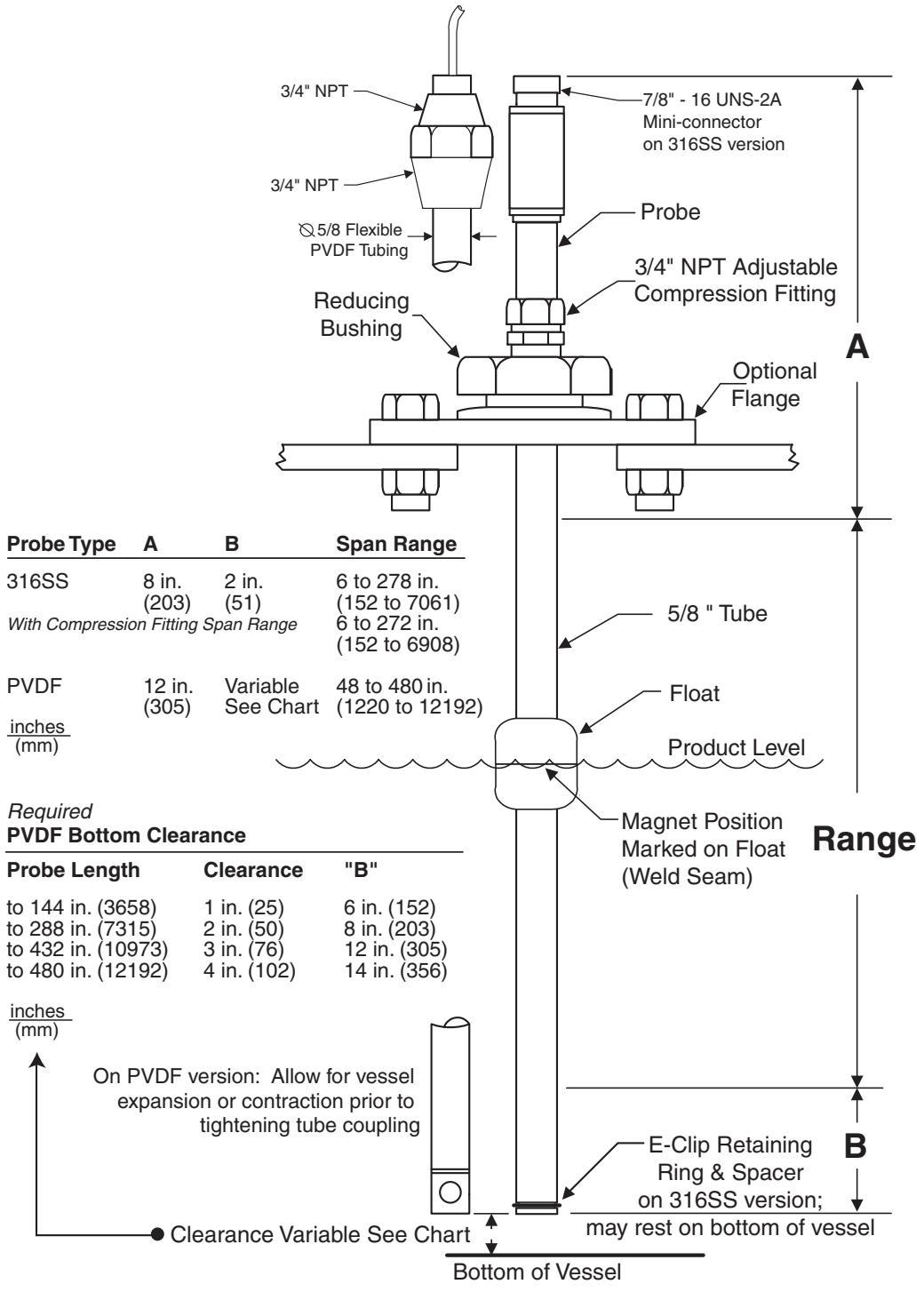
- Place the level gauge in a reasonably accessible location. Ambient temperature should be between -20°F and 158°F (-4°C to 70°C).

- Mount the probe perpendicular with gravity. See Figure 2-1.

- Float should have free movement along probe. Float dimensions are shown in Section 1.5.

- Float Retention Clip should be in place at base of probe.

2.2 Mounting Conditions (Continued)


3/4" NPT
3/4" NPT
⌀5/8 Flexible PVDF Tubing
7/8" - 16 UNS-2A Mini-connector on 316SS version
Probe
3/4" NPT Adjustable Compression Fitting
Reducing Bushing
Optional Flange
A
5/8 " Tube
Float
Product Level
Magnet Position Marked on Float (Weld Seam)
Range
B
E-Clip Retaining Ring & Spacer on 316SS version; may rest on bottom of vessel
Clearance Variable See Chart
Bottom of Vessel
On PVDF version: Allow for vessel expansion or contraction prior to tightening tube coupling
inches (mm)

Probe Type	A	B	Span Range
316SS	8 in. (203)	2 in. (51)	6 to 278 in. (152 to 7061)
With Compression Fitting Span Range			6 to 272 in. (152 to 6908)
PVDF	12 in. (305)	Variable See Chart	48 to 480 in. (1220 to 12192)

inches (mm)

Required
PVDF Bottom Clearance

Probe Length	Clearance	"B"
to 144 in. (3658)	1 in. (25)	6 in. (152)
to 288 in. (7315)	2 in. (50)	8 in. (203)
to 432 in. (10973)	3 in. (76)	12 in. (305)
to 480 in. (12192)	4 in. (102)	14 in. (356)

inches (mm)

Figure 2-1
Installation Diagram

2.3 Mounting Considerations

Mounting considerations may vary (Flanges, Compression Fitting, etc.) depending on the application. For underground tanks, the probe is generally mounted in the riser, resting on the bottom of the tank. Spacers are used to hold the sensor in the riser and a cable is suspended from the tank cap.

While most underground tanks are horizontal and fairly standard in design, above ground tanks vary considerably. The requirements for mounting these probes are fairly simple.

Since the sensor requires a float to provide level position, there is a minimum size required for insertion of the float into the tank. It is recommended that a minimum of 2" diameter be used for the most reliable system.

The size and material of the float being used will have a slight impact on the overall accuracy of the measuring system. In general, the larger the float the easier it is to provide a high accuracy measurement.

2.4 Stainless Steel Probe Mounting

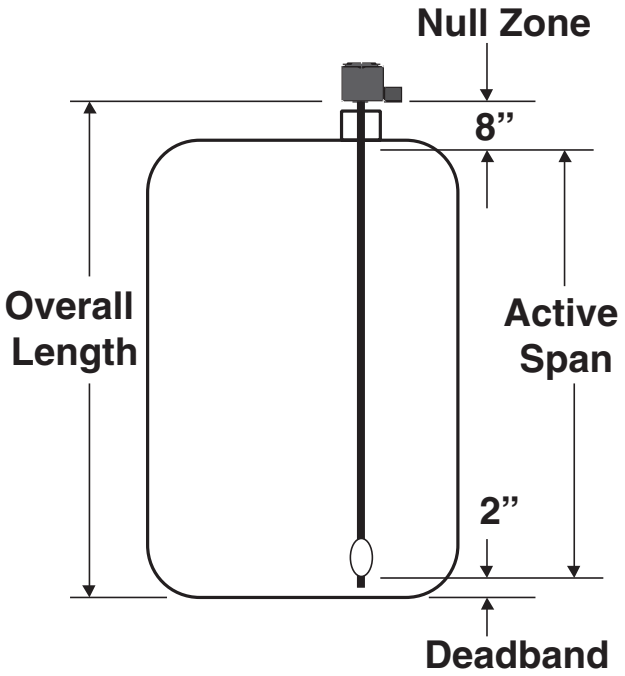


Figure 2-2
SS Probe up to 288" (7315mm)

2.4.1 Sizing of Stainless Steel Probe

Insertion Length is: Actual length from mounting point to bottom of tank.

Overall length of probe is: Insertion Length plus 2 inches (51mm) for Flange mounted probe, and Insertion Length plus 6 inches (152mm) for Compression Fitting mounted probe.

If the probe rests on the bottom of the tank, then the Active Range of the probe is the Overall Length minus 10 inches (254mm) **[2" (51mm) Dead Band at bottom of the probe and 8" (203mm) for the Null Zone at the top of the probe]**.

NOTICE

The amount of Active Range in a tank will vary, depending on the mounting style.

Stainless Steel probes are available in lengths up to 24 feet (7.3m). Due to difficulty with shipping and installation on site, it is recommend 16 to 18 feet (4.9 to 5.4m) as maximum length for this style probe, if practical.

Most of the SS Probes are mounted with probe end resting on bottom of the tank (for non pressurized tanks) or about ½" (12.7mm) from bottom (for pressurized tanks) and held in position with compression fitting at top of tank. A 5/8" x ¾" adjustable fitting is used to mount probe to a flange or adapter. Minimum process connection depends on the diameter of float, but it is suggested to use 2" NPT or larger.

If this compression fitting is used, fitting should be should be positioned below "crimp" in tube or a minimum of 4 inches (102mm) from the top of probe. Hand tighten fitting in a non-pressurized tank. This will allow for a slight movement of probe when tank expands or contracts. If tank is pressurized, fitting must be tightened.

If a flange is being used, a "D" style connector can be specified to thread probe directly into flange. This requires more accuracy in specifying overall length of probe, but eliminates need for compression fitting or adapter bushing. Contact factory if Welded Flange connection is required.

2.4.2 Assembly of Stainless Steel Probe

1. Standard SS Float Kit should contain a 2 inch 316 stainless steel float, spacer and retainer to hold float on to probe. The standard retainer is a 316 SS "E-Clip". Optionally, if the probe is to rest on the bottom of a metal tank, an ECTFE End-Cap may be supplied With either, a spacer is required to insure SS float is positioned in active area of span.

2. Two people are recommended for assembly of probe, one to hold the probe and the other to assemble components.

3. Slide compression fitting if it is being used on probe.

4. Slide reducing bushing or flange on to probe.

5. Slide float onto probe. Magnet is located in middle of the float, so orientation of float does not make any difference.

6. Slide spacer onto probe.

7. Capture all of these parts with E-Clip or ECTFE foot.

NOTICE

At this point, if probe span is to be set outside the vessel, then go to Section 2-9 Setting Span before continuing.

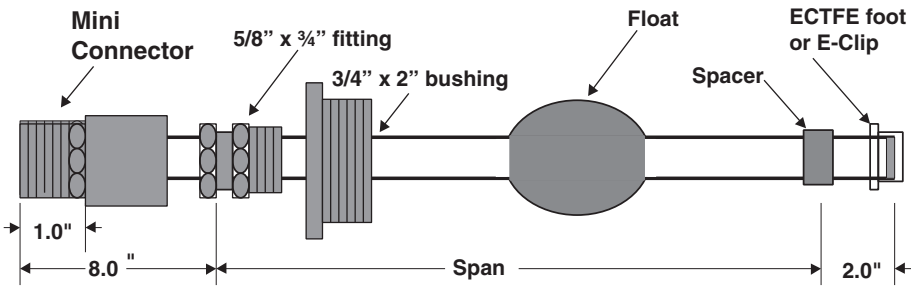


Figure 2-3
Stainless Steel Probe Assembly Sequence

2.4.3 Insertion of Stainless Steel Probe

CAUTION:
Do not allow float to drop suddenly since it can damage retainer at end of probe.

1. Insert bottom end of probe into tank.
2. Thread bushing into tank or flange. Bolt flange into position.
3. Thread compression fitting into bushing or flange.
4. Hand tighten. To insure compression fitting is sealed, turn fitting 1 ¼ turns after hand tightening.
5. Make final check to see that all of bolts and screws are in proper position and probe is securely tightened.

2.5 Flexible Polyvinylidene Fluoride (PVDF) Probe Mounting

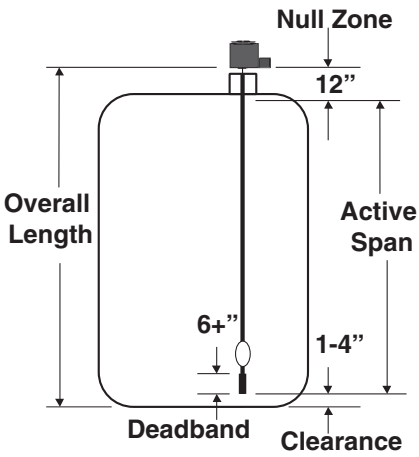


Figure 2-4
PVDF Probe up to 480" (12.2 m)

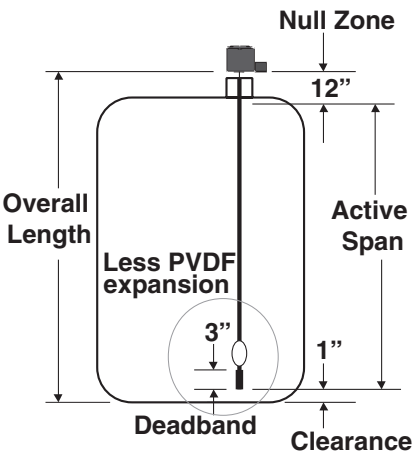


Figure 2-5
PVDF Probe version for Limited Temperature Range "C" Version

2.5.1 Sizing of PVDF Probe

Insertion Length: The actual height of the tank from the mounting point to the bottom of the tank.

Clearance: The distance from the bottom of the tank required for probe expansion at higher temperatures.

Dead Band: Inactive area at the bottom of the probe. The spacer used at the bottom of the tank to insure the float will be in the active range during contraction of the probe.

Null Zone: The inactive area at the top of the probe where the electronics are located.

Active Range: Is the Insertion Length minus the Clearance + Deadband plus 5" (127mm) for the Null Zone. See Table 2-1 below to determine the variable dimensions.

PVDF Probes Without a Weight Kit are usually those less than 10 feet (3.1m) in length. They have a Float Kit that comes with a special spacer and pin that must be used to prevent float from entering the deadband at the end of the probe.

"C" version PVDF probes are for limited temperature ranges of -4°F to 120°F (-20°C to 49°C). They come with a spacer and upper level float collar. They have a 3" (76mm) deadband at the bottom of the probe because of less need for expansion room at those temperatures. The Null Zone on the "C" version is 9".

PVDF Probes Requiring a Weight Kit, come with the weight and retainer pin along with the float made of either 316SS or PVDF, depending upon the application requirements. Deadband is variable, *See Table 2-1*.

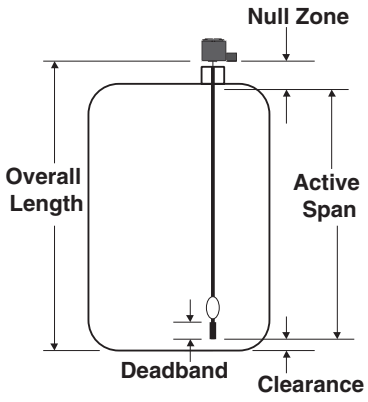


Figure 2-6
PVDF Probe

Length	Clearance	Dead Band	Null Zone	Spacer
0-144 in (0 - 3660 mm)	1 in (25 mm)	6 in (152 mm)	12 in (305 mm)	5 in (127 mm)
145-288 in (368 - 7320 mm)	2 in (51 mm)	8 in (203 mm)	12 in (305 mm)	7 in (178 mm)
289-432 in (7.34 - 11 m)	3 in (76 mm)	12 in (305 mm)	12 in (305 mm)	11 in (279 mm)
433-600 in (11 - 15.2 m)	4 in (102 mm)	14 in (356 mm)	12 in (305 mm)	13 in (330 mm)

Table 2-1
Variable Dimensions for PVDF Probe

2.5.2 Assembly of PVDF Probe

CAUTION!
Do NOT unwind coiled probe until actually feeding into vessel! Damage will occur.

Assembly of a PVDF probe is almost the same as 316 SS probe, except that a weight is used for probes longer than 16 feet (3.66m) long to keep the probe perpendicular. A weight also may be needed for probes being used in agitated applications less than 12 feet in length.

PVDF probes up to 16 feet (4.88m) in length are relatively rigid and shipped in the same way as 316 SS probes. PVDF probes longer than 16 feet are coiled and shipped in a box. Longer probes must be handled carefully to avoid damaging the electronics mounted within the tube. A Nylon Compression fitting and PVC reducer bushing are available for use with the PVDF probe.

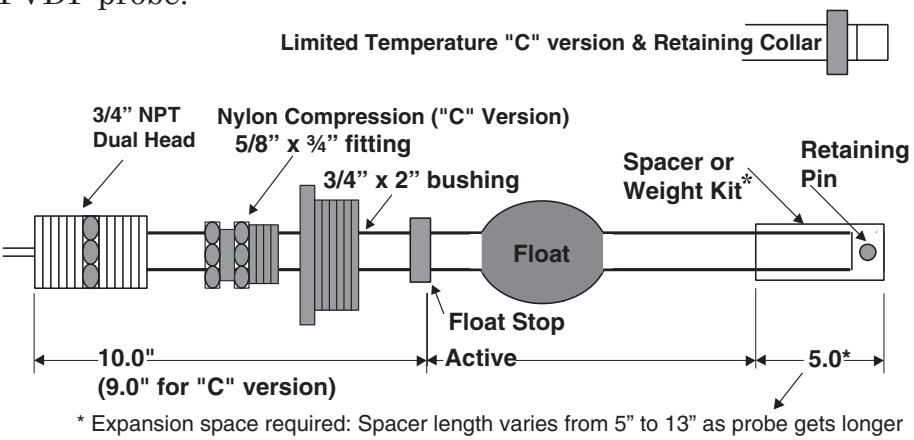


Figure 2-7
PVDF Probe Assembly Sequence

2.5.3 Before Insertion of PVDF Probe

NOTICE

At this point, if probe span is to be set outside the vessel, then go to Section 2-9 Setting Span before continuing... BUT READ THIS FIRST!

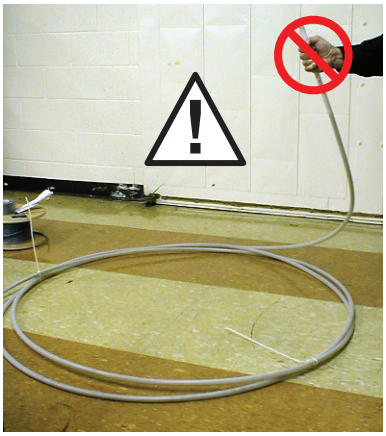
If necessary to set the span outside of the tank, take extra precaution to avoid damaging the flexible probe. Note that the longer probes are coiled and have numbered tie wraps.

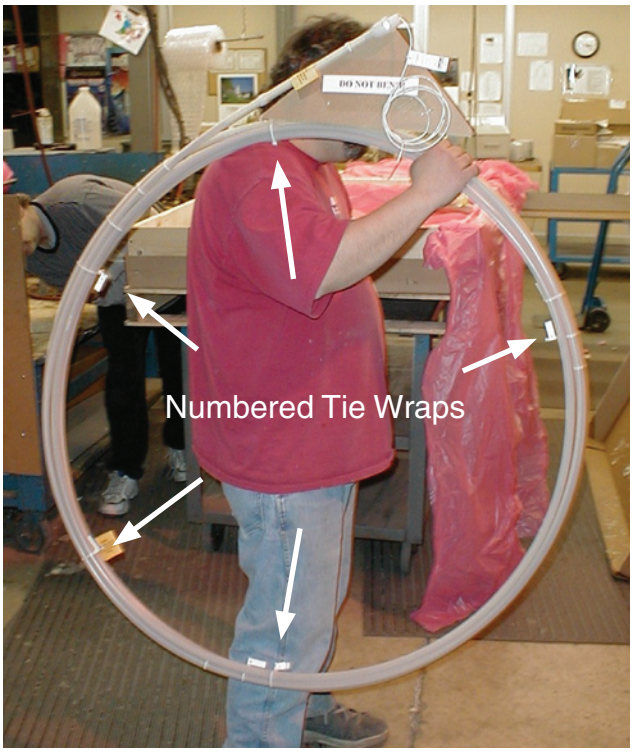
If you uncoil the probe outside of the tank to set the zero and span, it is important to recoil the probe, before installation. The probe coil should be approximately 48 inches in diameter and the coils should always remain parallel with each other.

If you lift a coil perpendicular to the rest of the coils, you can kink the probe. The kink generally cannot be straightened out and results in damage to the Wave Guide in the tube.

NOTICE

Kinking is considered user damage and is NOT covered under warranty!





NOTICE

Supporting tie wraps are numbered in the order that they must be removed to avoid damage to Flexible PVDF coil.
See section 2.5.4, typically a second person is recommended to avoid improper bending of PVDF tubing during installation.

2.5.4 Insertion of PVDF Probe

NOTICE

Longer probes are coiled and have numbered tie wraps. When installing probe, cutting tie wraps in sequence helps to prevent the installer from accidentally twisting the probe.

1. Two people are needed, one to hold the assembled section of the probe and guide the probe into the tank, and the other to keep the coils parallel and unwrap them in sequentially.
2. Thread bushing into tank or flange. Bolt flange into position.
3. Thread compression fitting into bushing or flange.
4. Hand tighten. To insure compression fitting is sealed, turn the fitting 1 ¼ turns after hand tightening. Do not over tighten compression fitting if it is being used.
5. Make final check to see that all of the bolts and screws are in proper position and probe is securely tightened.

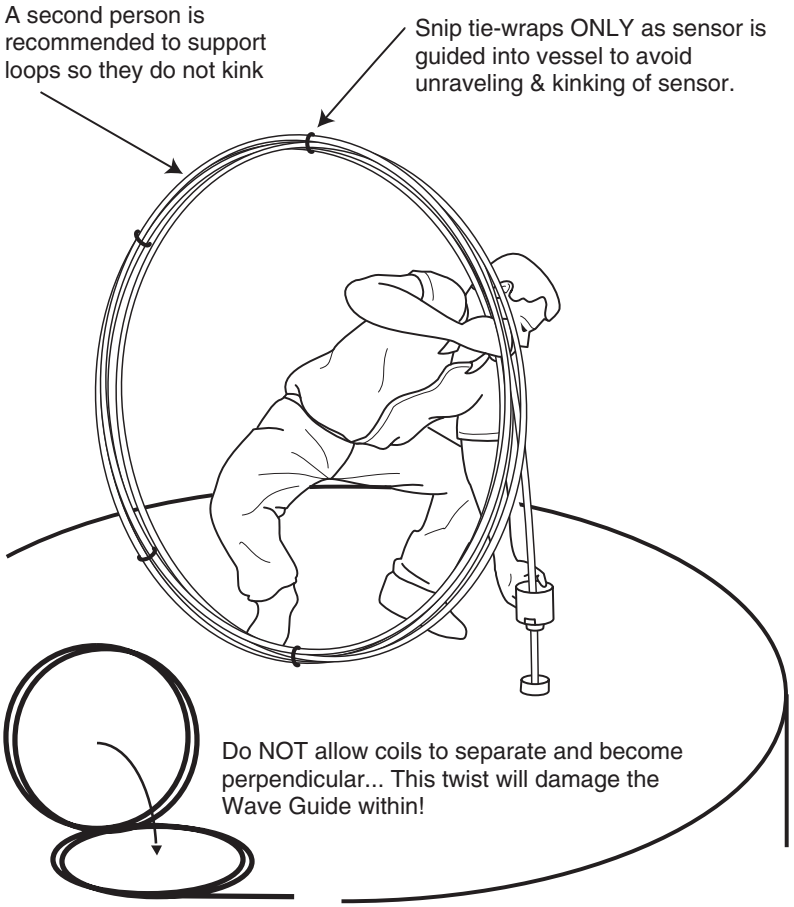

A second person is recommended to support loops so they do not kink
Snip tie-wraps ONLY as sensor is guided into vessel to avoid unraveling & kinking of sensor.
Do NOT allow coils to separate and become perpendicular... This twist will damage the Wave Guide within!

Figure 2-8
Inserting PVDF Probe

2.6 Mounting Optional Housing

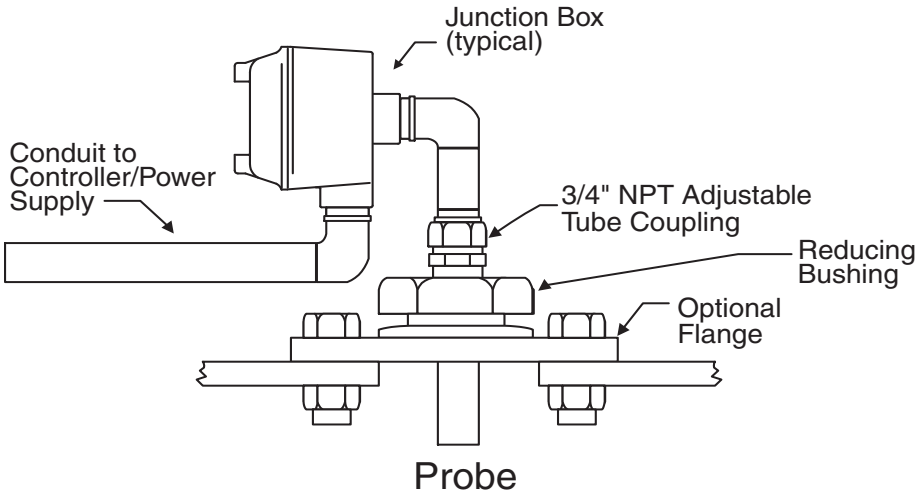


Figure 2-9
Mounting Optional Housing Junction Box
on Right Angle Connector Version
(DM330 "R" Option)

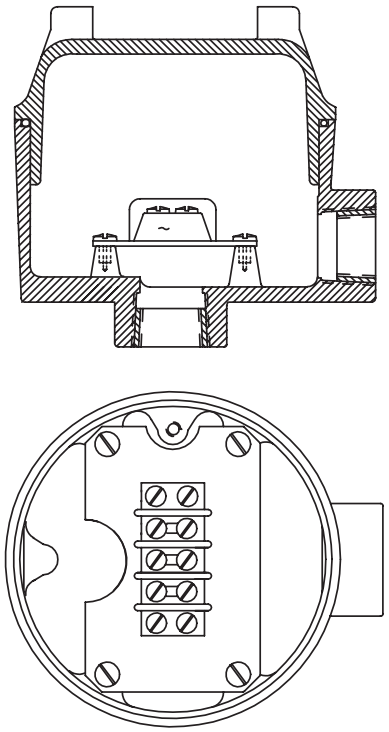


Figure 2-10
Housing Junction Box

2.7 Wiring

The AMETEK Drexelbrook Magnetostrictive Level sensor uses solid state surface mount electronics within the probe itself, providing a two-wire 4-20 mA output externally powered from the loop itself. Operating voltage is from 13.5 to 30 Vdc.

Refer to ***Figures 2-13, 14, & 15*** for the wiring connections.

CAUTION
Before setting the Span in a hazardous area, make sure the programming wire is properly protected through a Safety Barrier. See the wiring instructions and Installation Drawing 420-0004-233-CD for the proper connections.

Wiring Colors		
Signal	**US**	**EU**
IN +	RED	BROWN
IN -	BLACK	BLACK
PROGRAM	WHITE	BLUE
CHASSIS	GREEN	WHITE

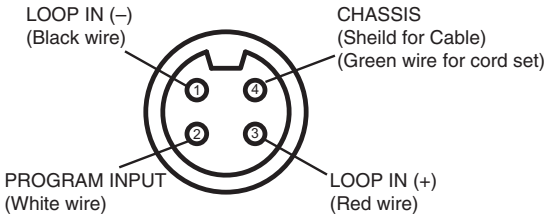


Figure 2-11
"M" Probe Connector

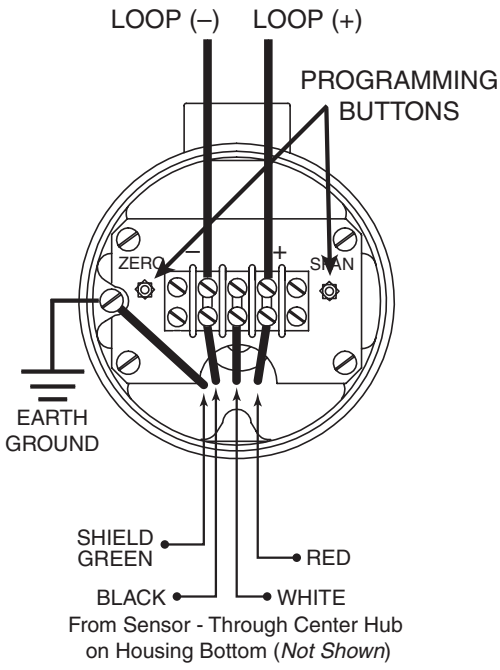


Figure 2-12
"H" Housing Option

NOTICE

For Explosion-Proof Installations See Page 38

2.7 Wiring (Continued)

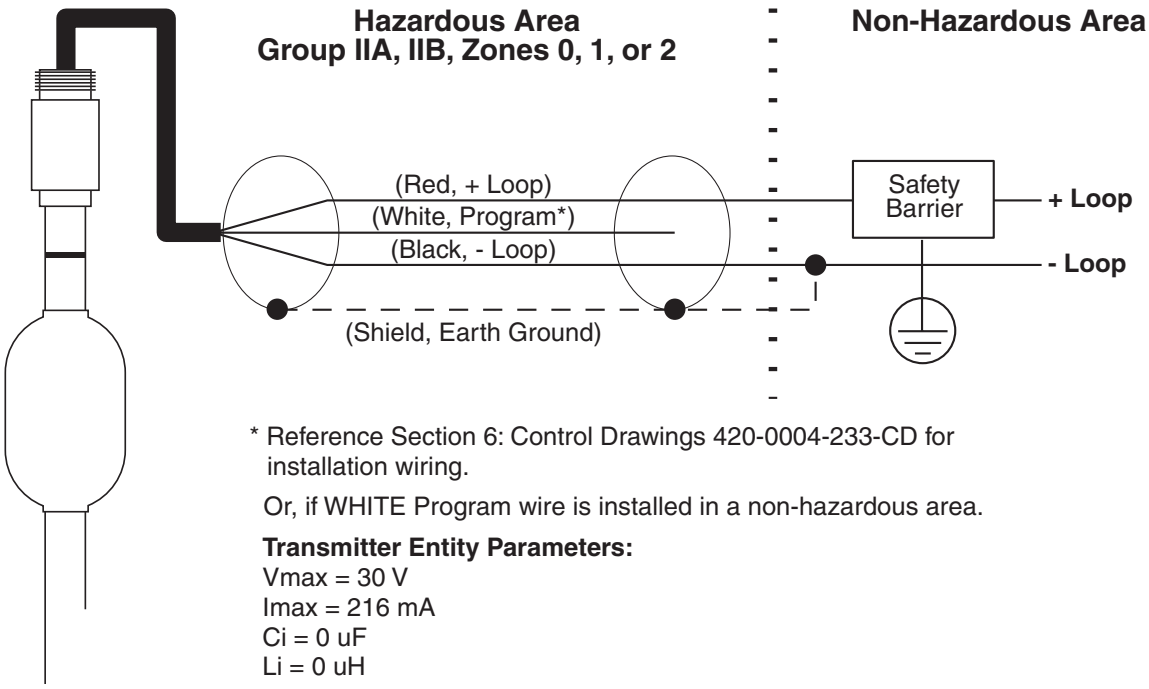

Hazardous Area
Group IIA, IIB, Zones 0, 1, or 2
Non-Hazardous Area
(Red, + Loop)
(White, Program*)
(Black, - Loop)
(Shield, Earth Ground)
Safety Barrier
+ Loop
- Loop
* Reference Section 6: Control Drawings 420-0004-233-CD for installation wiring.
Or, if WHITE Program wire is installed in a non-hazardous area.
Transmitter Entity Parameters:
Vmax = 30 V
Imax = 216 mA
Ci = 0 uF
Li = 0 uH

Figure 2-13
Wiring Diagram

2.7.1 Intrinsically Safe (IS) Applications

The intrinsically safe barrier must be selected with entity parameters of:

Voc less than or equal to 30 V.
Isc less than or equal to 216 mA.

Total loop capacitance and inductance of wire should not exceed the Ca and La of barrier for the appropriate Class and Group. Use 60pF per foot and 0.2 micro H per foot for the wire, if these parameters are not known.

Resistive impedance of all devices in current loop (including wire, meter, or controller, and barrier) should not exceed 500 ohms.

Voltage output of the I.S. power supply should be at least 13.5 V at sensor after considering voltage drops across all other resistance in loop. I.S. power supply voltage should not exceed Vmax of barrier.

2.7.2 Intrinsically Safe Barriers

Select either a single or dual channel barrier.

Single channel barrier can only be used if meter (resistive load) is placed in the positive end of loop and meter has a differential input. Refer to Figure 2-16.

If the meter (resistive load) must have one side connected to ground, then a dual channel barrier must be used. Refer to ***Figure 2-17.***

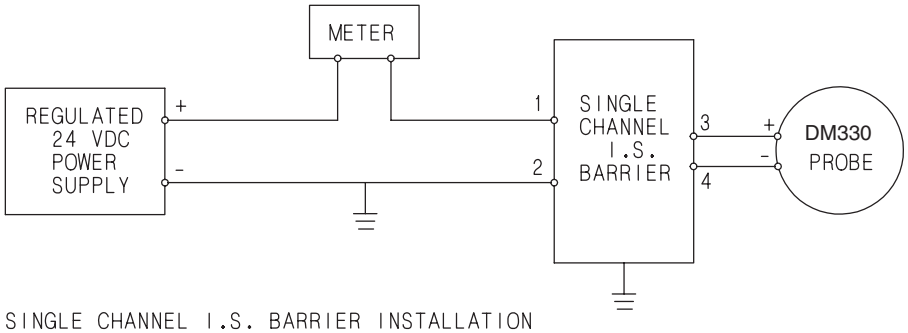


Figure 2-14
Single Channel Barrier

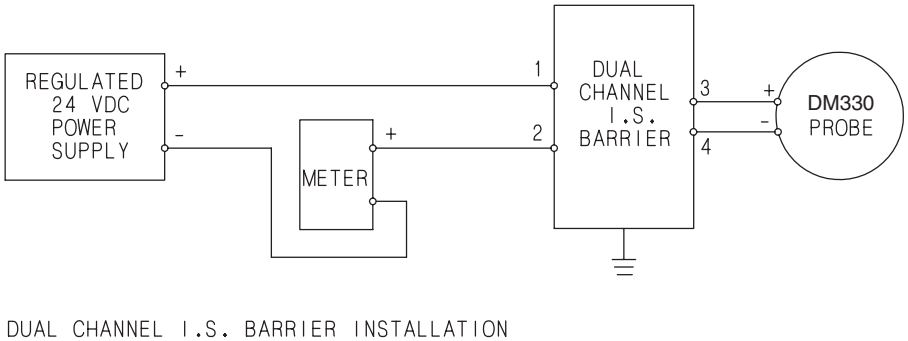


Figure 2-15
Dual Channel Barrier

2.7.3 Intrinsically Safe Power Supply

The I.S. power supply should have at least a 24 VDC output, and no more than 1000 feet of 16 gauge wire in the loop.

2.8 Loop Configuration of 4mA & 20mA Control Points

Loop configuration of 4mA and 20mA control points can be set either outside the vessel or within the vessel. If the configuration is set inside the vessel, then actual level position within the vessel is used to set the 4mA and 20mA positions. If this is not practical, the probe should be "Bench Configured". The system requires Intrinsically Safe power, so setting the Zero and Span points can be done in a hazardous area.

2.8.1 Manually

1.) Power-up the probe
2.) Place float at desired 4mA / 20mA position
3.) Unlock the configuration program by momentarily "Shorting" the White Program Wire (Blue in EU) to the Black Loop "-" Wire (Based on the security timing sequence in Section 2.8.3)
4.) The 4mA control point is set by momentarily "Shorting" the White Program Wire (Blue in EU) to the Black Loop "-" Wire (Based on the security timing sequence in Section 2.8.3)
5.) The 20mA control point is set by momentarily "Shorting" the White Program Wire (Blue in EU) to the Red Loop "+" Wire (Brown in EU) (Based on the security timing sequence in Section 2.8.3)
6.) Loop configuration is complete

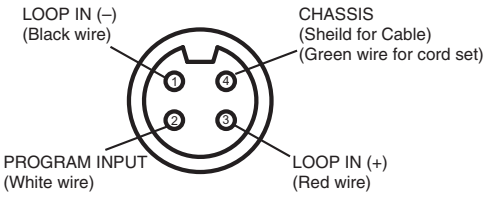


Figure 2-16
"M" Probe Connector

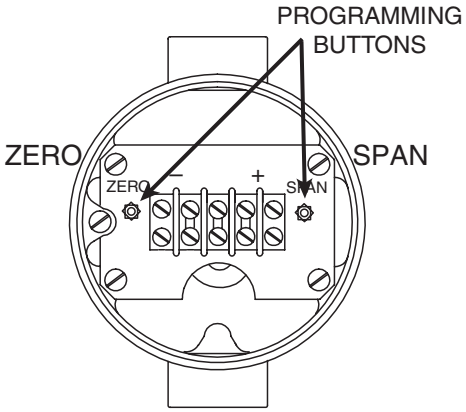


Figure 2-17
"H" Housing Option

2.8.2 Optional Housing with Push Buttons

1.) Power-up the probe
2.) Place float at desired 4mA / 20mA position
3.) Unlock the configuration program by momentarily pressing the Zero pushbutton (Based on the security timing sequence in Section 2.8.3)
4.) The 4mA is set by momentarily pressing the Zero pushbutton (Based on the security timing sequence in Section 2.8.3)
5.) The 20mA is set by momentarily pressing the Span pushbutton (Based on the security timing sequence in Section 2.8.3)
6.) Loop configuration is complete

2.8.3 Security Timing Sequence for Loop Configuration of 4mA & 20mA Control Points

The Security Timing Sequence protects the DM330 Series from unintentional configuration (Or changes in configuration) of the 4mA & 20mA control points

1.) Power-up the probe
2.) Place float at desired 4mA / 20mA position
3.) Unlock the configuration program by “Shorting” the White Program Wire (Blue in EU) to the Black Loop "-" Wire for three (3) seconds. See figure 2-18 for full timing sequence.
4.) Release the Short for three (3) seconds
5.) Set Zero or Span by “Shorting” either the (4mA) Black Loop "-" Wire (Blue in EU) or by “Shorting” the (20mA) Red Loop "+" Wire (Brown in EU) to the White Program Wire for two (2) seconds.
6.) The DM330 Series “Locks” the programming menu after ten seconds from time of entering the program.
   (A.) It will be necessary to enter the Security Timing Sequence twice to set both 4mA & 20mA control points

2.8.4 Optional Housing with Push Buttons

1.) Unlock the configuration program by pressing the Zero pushbutton for three (3) seconds. See figure 2-18 for full timing sequence.
2.) Release the Zero pushbutton for three (3) seconds
3.) Set Zero or Span by pressing either the Zero pushbutton or by pressing the Span pushbutton for two (2) seconds.
4.) The DM330 Series “Locks” the programming menu after ten (10) seconds from time of entering the program.
a.) It will be necessary to enter the Security Timing Sequence twice to set both 4mA & 20mA control points

2.8.4 Optional Housing with Push Buttons (Continued)

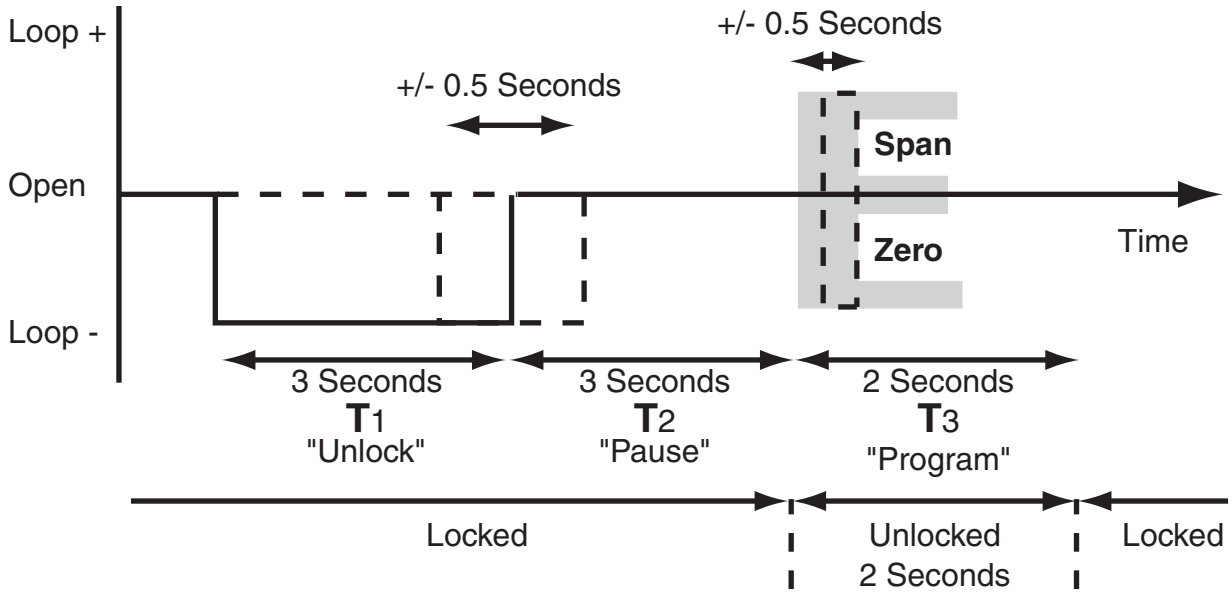


Figure 2-18
Security Timing Sequence

2.9 Correlating Level

Once the Magnetostrictive Level Probe has been installed, the output may not be "accurate." The actual level and the position of the probe in the tank need to be correlated. You might need to adjust the span to be consistent with the actual tank conditions if the span was set outside of the tank. Other than an adjustment to a reference value, there is no other "calibration" required.

Section 3

Section 3: Operation

The Magnetostrictive Level System is used for accurate and repeatable measurement of linear motion and liquid level.

All of the sensor's electronics are integrated into the probe. Magnetostrictive technology uses a float with an embedded magnet that travels along the 5/8-inch diameter tube. Inside the tube is a wire that is pulsed with a current that travels down the wire. As the current pulse intersects the magnetic field of the float, a reflection creates torsion on the wire that is sensed by electronic module providing a linear 4-20 mA output.

The instrument needs only to be installed and fixed in position. There are no adjustments or calibration. The sensor is a fixed length. Scaling or offset is done in the customer's process controller[1].

[1]Any controller capable of accepting a 4-20 mA current loop input is suitable for use with this transmitter.

Section 4

Section 4: Troubleshooting

4.1 Symptom Chart

Symptom	Troubleshooting Tip
No Signal Received at controller	• Check that power is applied to controller • Check wiring connection to probe • Check process temperature [cannot exceed 230ºF (110ºC)]
Output is Under 4mA	• Be sure float is in place and not stuck. • Be sure float retention clip is in place at base of probe • Check automatic gain control (if output is 3.8mA)
Output appears erratic	• Be sure probe is mounted perpendicular with gravity • Check float for free movement along probe • Check automatic gain control
Output appears to be going down, yet tank is filling	• Check configuration of 4mA & 20mA points
Output appears to be going up, yet tank is emptying	• Check configuration of 4mA & 20mA points

4.2 Internal Diagnostics (All diagnostic values with tolerances ±0.02 mA)

4.2.1 During Normal Operation:

1. Absence of Magnet Signal, Wire Break, or float outside active range is Indicated as 3.8 mA
2. Selected Span beyond 4 mA Set Point is indicated as 3.9 mA
3. Selected Span beyond 20 mA Set Point is indicated as 20.1 mA

4.2.2 "Lost Float" Diagnostic:

When Float gets stuck beyond span or active ranges, or end cap falls off and float slips away from probe, then outputs will indicate as shown to the right.

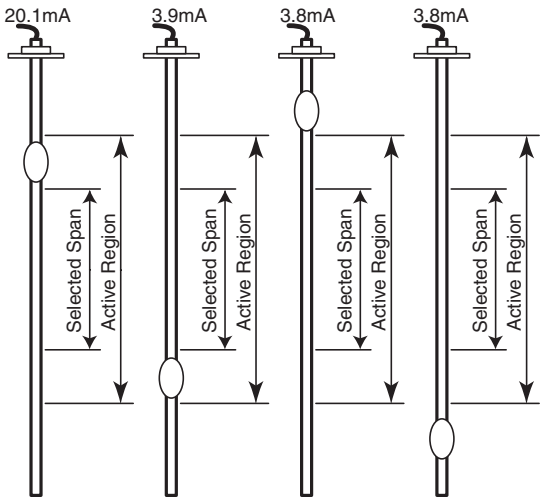


Figure 4-1
Built-in Diagnostics
Locate Float Position

4.3 Automatic Gain Control (AGC) (All diagnostic values with tolerances of +/- 0.02 mA)

The AGC does not require any adjustment in normal operation. If the signal becomes unstable or goes to 3.8 mA with the float in the active range of the probe, check the AGC as follows:

Open the probe housing in a Safe Area if application requires intrinsically safe approval.

4.3.1 Manual AGC test

1. Place float magnet near top of probe (if probe length is under 24 ft) or place the float magnet near the bottom of probe (if probe length is over 24 ft)
2. Short White (Program) wire to Black (negative Loop) wire and apply power to the probe.
3. The output will go from 12 mA to 20 mA if successful or to 3.8 mA if AGC failed.
4. Remove power from the system and remove the short (White wire to black wire).
5. Re-apply power and the system will return to normal operating mode (4-20mA) with new gain set.
6. If the system does not pass the AGC test or return to normal operation after completion of the above steps, contact the factory.

4.3.2 AGC test via Optional Housing Push buttons

1. Place float magnet near top of probe (if probe length is under 24 ft) or place the float magnet near the bottom of probe (if probe length is over 24 ft).
2. Press and hold the Zero Button and apply power to the probe.
3. The output will go from 12 mA to 20 mA if successful or to 3.8 mA if AGC failed.
4. Remove power from the system.
5. Re-apply power and the system will return to normal operating mode (4-20 mA) with new gain set.
6. If the system does not pass the AGC test or return to normal operation after completion of the above steps, contact the factory.

4.4 Factory Assistance

AMETEK Drexelbrook can answer any questions about The DM330 Series instrument. Call Customer Service at 1-800-553-9092 (US and Canada) or +1 215 674-1234 (International).

If you require assistance and attempts to locate the problem have failed:

Contact your local Drexelbrook representative,

Telephone the Service department toll-free:
- 1-800-527-6297 (US and Canada)
- +1 215 674-1234 (International)

FAX: Service Department + 215-443-5117
E-Mail: drexelbrook.service@ametek.com

Please provide the following information:

- Instrument Model Number
- Sensing Element Model Number and Length
- Original Purchase Order Number
- Material being measured
- Temperature
- Pressure
- Agitation
- Brief description of the problem
- Checkout procedures that have failed

4.5 Field Service

Trained field servicemen are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the service department for further details.

4.6 Customer Training

Periodically, AMETEK Drexelbrook instrument training seminars for customers are held at the factory. These sessions are guided by Drexelbrook engineers and specialists, and provide detailed information on all aspects of level measurement, including theory and practice of instrument operation. For more information write to:
AMETEK Drexelbrook, Communications/ Training Group
or call 215-674-1234.

4.7 Equipment Return

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved by the factory.

In many applications, sensing elements are exposed to hazardous materials.

- **OSHA mandates** that our employees be informed and protected from hazardous chemicals.
- **Material Safety Data Sheets (MSDS)** listing the hazardous materials to which the sensing element has been exposed MUST accompany any repair.
- It is your responsibility to fully disclose all chemicals and **decontaminate** the sensing element.

To obtain a return authorization (RA#), contact the Service department at 1-800-527-6297 (US and Canada) or + 215-674-1234 (International).

- Please provide the following information:
- Model Number of Return Equipment
- Serial Number
- Original Purchase Order Number
- Process Materials to which the equipment has been exposed.
- MSDS sheets for any hazardous materials
- Billing Address
- Shipping Address
- Purchase Order Number for Repairs
- Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:

AMETEK-DREXELBROOK.
205 KEITH VALLEY ROAD
HORSHAM, PA 19044-1499
COD shipments will not be accepted

Section 5: Specifications

Operating Voltage: Vs = 13.5 to 30 VDC, Loop Powered

Output: 4 to 20mA

Diagnostic Output: (Tolerance +/- 0.02mA)
3.9mA and 20.1mA, float outside of span
3.8mA, no signal received

Temperature Range:

- **Sensing Area** -20°C to 100°C (-4°F to 212°F) Not approved for hazardous locations above 70°C (158°F)
- **Electronics Area** -20°C to 70°C (-4°F to 158°F)

Pressure Rating: Stainless Steel: 1000psig Max. (69 bar)
PVDF (flexible): 150psig Max. (10 bar)

Resolution: 0.025% of Span or 0.014" (0.4 mm) [whichever is greater]

Tube Diameter: 5/8" O.D.

Repeatability: 0.014" + 0.05% of Span Typical
0.014" + 0.4% of Span Max.

Accuracy: 0.1% or 0.050" (1.27mm) [whichever is greater]

Resp./Update Time: 100 ms

Loop Resistance: ≤ [(Vs -13.5V)/ 0.0201A] Ohms, (522) Ohms Typical @ 24VDC

Null Zone: Stainless Steel: 8" (M, D, S), 9" (R)
PVDF (flexible): 12" (D), 9" (C)

Dead Band: Stainless Steel: 2" (all models)
PVDF (flexible): 3" (C), 6" to14" (D),
dependant on overall length (OAL)

Useable Span: All Models OAL - (Null Zone + Dead Band)

I.S. Barrier : See Control Drawing 420-0004-233-CD

Enclosure Rating: Optional Condulet: NEMA 4X - IP65
Sensor Material: 316SS or PVDF - IP68

Probe Length: Stainless Steel:
18" to 288" (457mm - 7315 mm) *depending on model*
PVDF (flexible):
25" - 480" (635mm - 12192 mm) *depending on model*

Entity Parameters: Vmax - 30 V
Imax - 216 mA
Pi - 1.0 W
Ci - 0 uF
Li - 0 mH

Section 6

Section 6: Approvals

6.1 Approvals Available

FM, CSA:

Intrinsically Safe

-20° C ≤ Tamb. ≤ +70° C
Class I, II, III, Div. 1
Groups C, D, E, F, and G, T4
Class I, Div. 2
Groups A, B, C, D, T4
Class I, Zone 0, AEx ia IIB T4

Install Per 420-0004-233-CD

ExplosionProof

Class I, DIV 1 Groups A,B,C,D T4
Class II, DIV 1 Groups E,F,G T4
Class III DIV 1 T4
-40° C ≤ Tamb. ≤ +70° C

Install Per 420-0004-342-CD

ATEX:

EEx ia IIB T4
NEMKO 04 ATEX 1469X
0344 II 1G

Sanitary:

74-02

Specifications are subject to change without notice

6.2 EC Declaration of Conformity

420-0004-275		Sht. 1 of 1	APP'D BY SGA
ISSUE	EDO NO.	APP'D	DATE
1	10-04-214	THP	10/12/04
2	8-06-101	SGA	8/1/06

EC Declaration of Conformity

Manufacturer: AMETEK Drexelbrook
205 Keith Valley Road, Horsham PA 19044 USA

Identification of Equipment: Series DM330 Liquid Level Sensor

Description of Device:
These devices are permanently mounted Intrinsically Safe Magnetostrictive based liquid level sensing transducers. The level information is conveyed by an analog 4-20mA output signal. The sensor is loop powered with a maximum power supply voltage of +30Vdc. The devices can be specified with either PVDF or steel housing materials.

EC type certificate: NEMKO 04ATEX1469X
Quality certificate: KEMA 04ATEXQ3213

Conformity Specifications:

Council Directives:

Directive 94/9/EC, ATEX
Directive 89-336-EEC, EMC

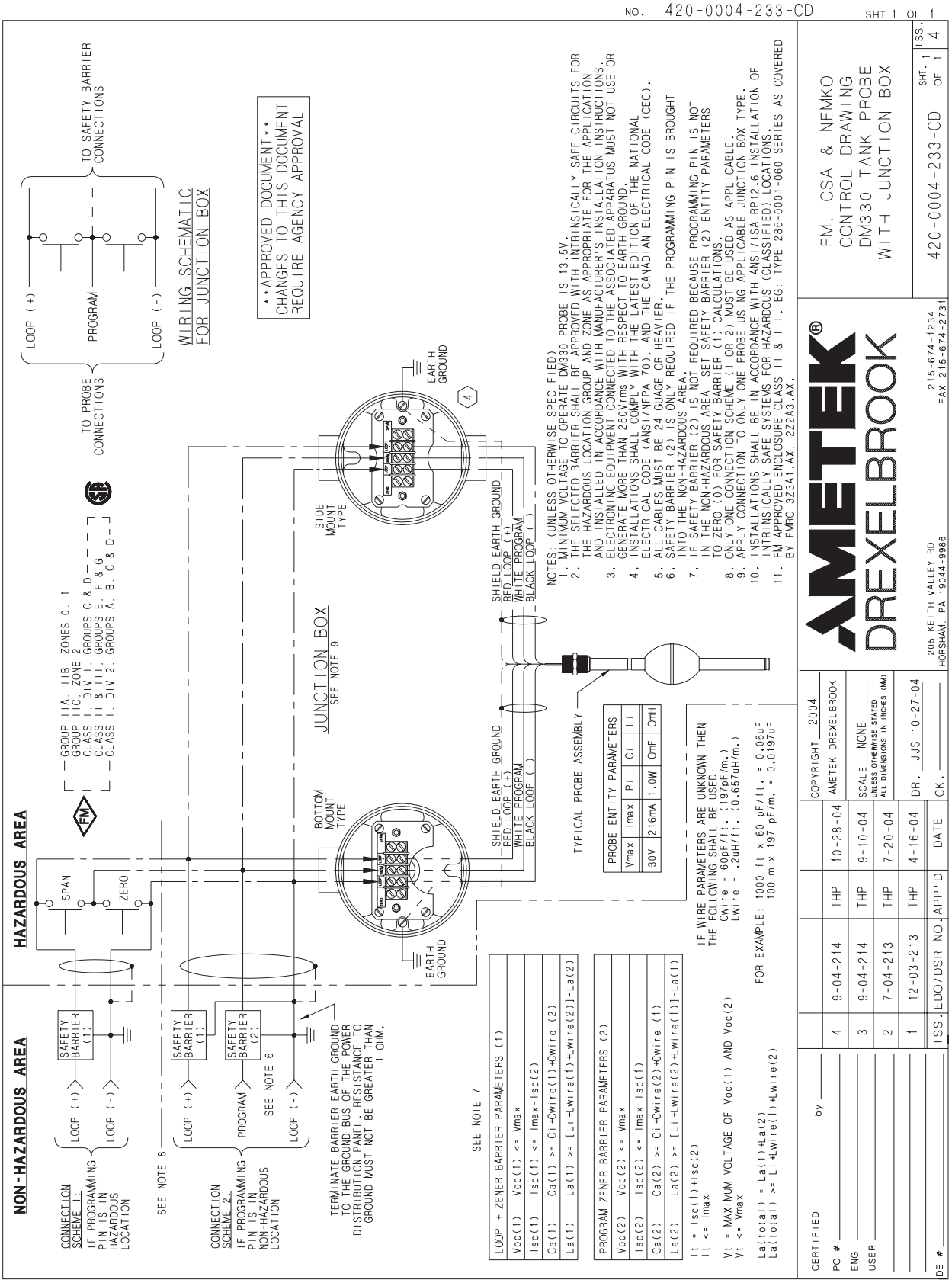
Harmonized Standards:

EN50014:1997	Electrical apparatus for potentially explosive atmospheres – General Requirements
EN50020:2002	Electrical Apparatus for potentially explosive atmospheres – Intrinsic Safety 'i'
EN50284:1999	Special requirements for construction, test and marking of electrical apparatus of equipment group II, Category 1 G
EN55011:1998	Limits and methods of measurement of radio characteristics of industrial, scientific and medical (ISM) Radio Frequency equipment, Class B, Group 1
EN61326:2002-02	Electrical Equipment for measurement, control and laboratory use – EMC Requirements
EN61000-4-2:1995	Electrostatic Discharge Immunity
EN61000-4-3:1995	Radiated RF Immunity

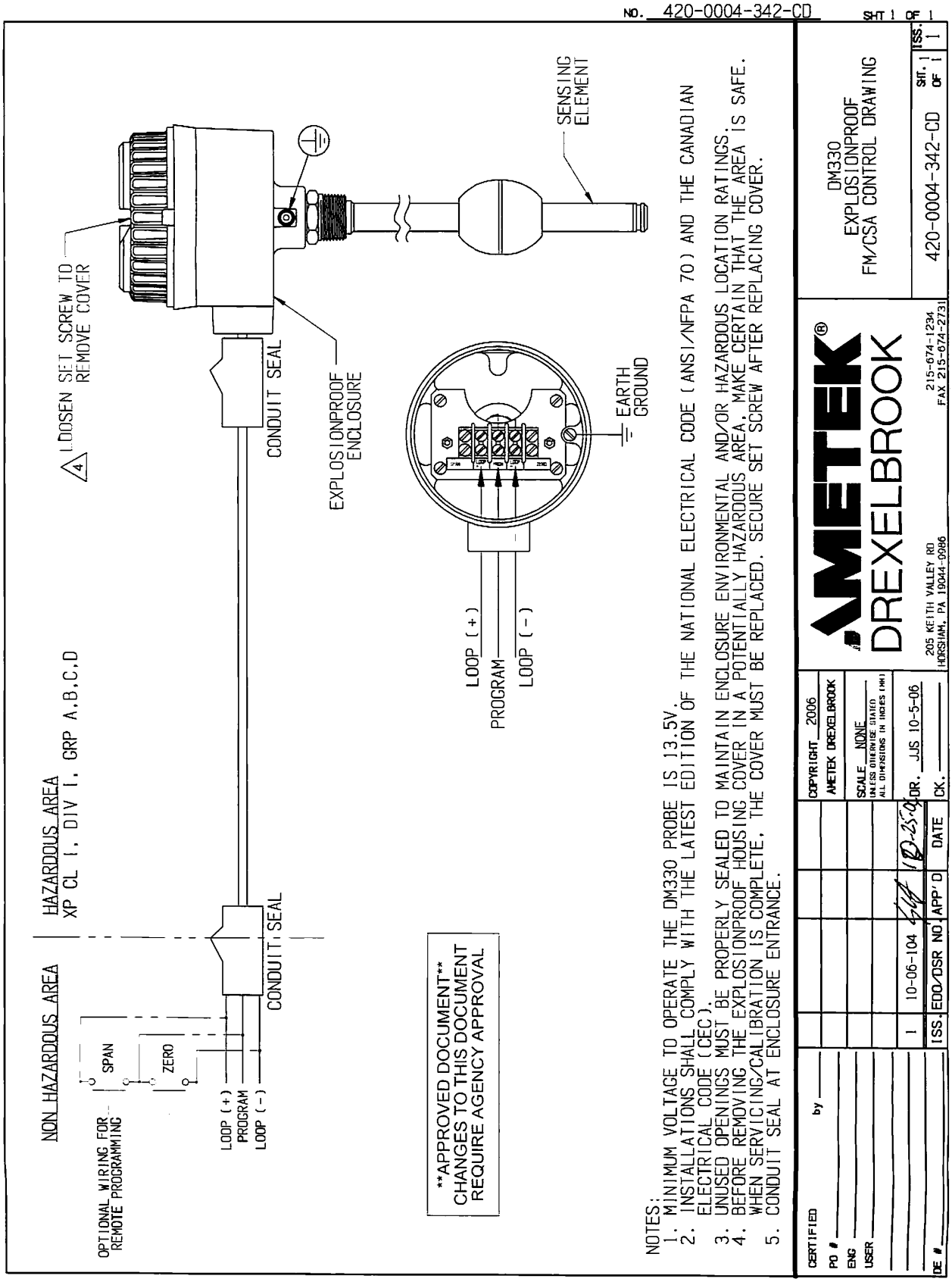
Signed:

Name: Steven G. Arnold **Date:** 8/1/06
Position: QA Manager **Company:** AMETEK Drexelbrook

Section 7: Control Drawings


NO. 420-0004-233-CD
SHT 1 OF 1
NON-HAZARDOUS AREA
HAZARDOUS AREA
CONNECTION SCHEME 1
IF PROGRAMMING PIN IS IN HAZARDOUS LOCATION
CONNECTION SCHEME 2
IF PROGRAMMING PIN IS IN NON-HAZARDOUS LOCATION
SAFETY BARRIER (1)
SAFETY BARRIER (2)
LOOP (+)
LOOP (-)
PROGRAM
SPAN
ZERO
SEE NOTE 8
SEE NOTE 6
SEE NOTE 7
TERMINATE BARRIER EARTH GROUND TO THE GROUND BUS OF THE POWER DISTRIBUTION PANEL. RESISTANCE TO GROUND MUST NOT BE GREATER THAN 1 OHM.
GROUP IIA, IIB ZONES 0, 1
GROUP IIC, ZONE 2
CLASS I, DIV 1: GROUPS C & D
CLASS II & III: GROUPS E, F & G
CLASS I, DIV 2: GROUPS A, B, C & D
JUNCTION BOX
SEE NOTE 9
BOTTOM MOUNT TYPE
SIDE MOUNT TYPE
EARTH GROUND
SHIELD EARTH GROUND
RED LOOP (+)
WHITE PROGRAM
BLACK LOOP (-)
TYPICAL PROBE ASSEMBLY
TO PROBE CONNECTIONS
TO SAFETY BARRIER CONNECTIONS
WIRING SCHEMATIC FOR JUNCTION BOX
APPROVED DOCUMENT
CHANGES TO THIS DOCUMENT REQUIRE AGENCY APPROVAL
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. MINIMUM VOLTAGE TO OPERATE DM330 PROBE IS 13.5V.
2. THE SELECTED BARRIER SHALL BE APPROVED WITH INTRINSICALLY SAFE CIRCUITS FOR THE HAZARDOUS LOCATION GROUP AND ZONE AS APPROPRIATE FOR THE APPLICATION AND INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
3. ELECTRONINC EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250Vrms WITH RESPECT TO EARTH GROUND.
4. INSTALLATIONS SHALL COMPLY WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70). AND THE CANADIAN ELECTRICAL CODE (CEC).
5. ALL CABLES MUST BE 24 GUAGE OR HEAVIER.
6. SAFETY BARRIER (2) IS ONLY REQUIRED IF THE PROGRAMMING PIN IS BROUGHT INTO THE NON-HAZARDOUS AREA.
7. IF SAFETY BARRIER (2) IS NOT REQUIRED BECAUSE PROGRAMMING PIN IS NOT IN THE NON-HAZARDOUS AREA, SET SAFETY BARRIER (2) ENTITY PARAMETERS TO ZERO (0) FOR SAFETY BARRIER (1) CALCULATIONS.
8. ONLY ONE CONNECTION SCHEME (1 OR 2) MUST BE USED AS APPLICABLE.
9. APPLY CONNECTION TO ONLY ONE PROBE USING APPLICABLE JUNCTION BOX TYPE.
10. INSTALLATIONS SHALL BE IN ACCORDANCE WITH ANSI/ISA RP12.6 INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS.
11. FM APPROVED ENCLOSURE CLASS II & III. EG: TYPE 285-0001-060 SERIES AS COVERED BY FMRC 3Z3A1.AX. 2Z2A3.AX.
PROBE ENTITY PARAMETERS
Vmax | Imax | Pi | Ci | Li
30V | 216mA | 1.0W | 0mF | 0mH
LOOP + ZENER BARRIER PARAMETERS (1)
Voc(1) <= Vmax
Isc(1) <= Imax-Isc(2
Ca(1) >= Ci+Cwire(1)+Cwire (2)
La(1) >= [Li+Lwire(1)+Lwire(2)]-La(2)
PROGRAM ZENER BARRIER PARAMETERS (2)
Voc(2) <= Vmax
Isc(2) <= Imax-Isc(1)
Ca(2) >= Ci+Cwire(2)+Cwire (1)
La(2) >= [Li+Lwire(2)+Lwire(1)]-La(1)
It = Isc(1)+Isc(2)
It <= Imax
Vt = MAXIMUM VOLTAGE OF Voc(1) AND Voc(2)
Vt <= Vmax
La(total) = La(1)+La(2)
La(total) >= Li+Lwire(1)+Lwire(2)
IF WIRE PARAMETERS ARE UNKNOWN THEN THE FOLLOWING SHALL BE USED:
Cwire = 60pF/ft. (197pF/m.)
Lwire = .2uH/ft. (0.657uH/m.)
FOR EXAMPLE: 1000 ft x 60 pF/ft. = 0.06uF
100 m x 197 pF/m. = 0.0197uF
CERTIFIED by
PO #
ENG
USER
DE #
ISS. 4 | 9-04-214 | THP | 10-28-04
ISS. 3 | 9-04-214 | THP | 9-10-04
ISS. 2 | 7-04-213 | THP | 7-20-04
ISS. 1 | 12-03-213 | THP | 4-16-04
ISS. | EDO/DSR NO. | APP'D | DATE
COPYRIGHT 2004
AMETEK DREXELBROOK
SCALE NONE
UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)
DR. JJS 10-27-04
CK.
AMETEK®
DREXELBROOK
205 KEITH VALLEY RD
HORSHAM, PA 19044-9986
215-674-1234
FAX 215-674-2731
FM, CSA & NEMKO CONTROL DRAWING DM330 TANK PROBE WITH JUNCTION BOX
420-0004-233-CD
SHT. 1 OF 1
ISS. 4

Section 7: Control Drawings (Continued)



TERMS AND CONDITIONS OF SALE

AMETEK DREXELBROOK

GENERAL: ***ALL ORDERS ARE SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS. ANY ACCEPTANCE OF ANY OFFER OF BUYER FOR ANY GOODS OR SERVICES IS CONDITIONED UPON THESE TERMS AND CONDITIONS, AND SELLER OBJECTS TO ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER IN ANY DOCUMENT, WHICH SHALL NOT BE BINDING UPON SELLER.*** No salesman or other party is authorized to bind the AMETEK DREXELBROOK Division of AMETEK, Inc. (hereinafter "Seller") by any agreement, warranty, statement, promise, or understanding not herein expressed, and no modifications shall be binding on Seller unless the same are in writing and signed by an executive officer of Seller or his or her duly authorized representative. Verbal orders shall not be executed until written notification has been received and acknowledged by Seller.

QUOTATIONS: Written quotations are valid for thirty (30) days unless otherwise stated. Verbal quotations expire the same day they are made.

PRICES: All prices and terms are subject to change without notice. Buyer-requested changes to its order ("Orders"), including those affecting the identity, scope and delivery of the goods or services, must be documented in writing and are subject to Seller's prior approval and adjustments in price, schedule and other affected terms and conditions. Orders requiring certified test data in excess of commercial requirements, are subject to a special charge.

ORDER ACCEPTANCE: All Orders are subject to final approval and acceptance by Seller at its office located at 205 Keith Valley Road, Horsham, Pennsylvania 19044.

TERMS OF PAYMENT: Seller's standard terms of payment for Buyers who qualify for credit are net thirty (30) days from date of invoice. All invoices must be paid in United States dollars.

CREDIT: Seller reserves the right at any time to revoke any credit extended to Buyer or otherwise modify terms of payment if Buyer fails to pay for any shipments when due or if in Seller's opinion there is a material adverse change in Buyer's financial condition. Seller may, at its option, cancel any accepted Order if Buyer fails to pay any invoices when due.

DELIVERY: Shipments are F.O.B place of manufacture ("Shipping Point") and the Buyer shall pay all freight, transportation, shipping, duties, fees, handling, insurance, storage, demurrage, or similar charges from Shipping Point. Delivery of goods to common carrier shall constitute delivery and passing of title to the Buyer, and all risk of loss or damage in transit shall be borne by Buyer. Any claims or losses for damage or destruction after such delivery shall be the responsibility of Buyer.

Seller reserves the right to make delivery in installments which shall be separately invoiced and paid for when due, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Buyer of its obligation to accept remaining deliveries.

Acknowledged shipping dates are approximate only and based on prompt receipt of all necessary information from Buyer and Buyer's compliance with terms of payment.

TAXES: All sales, excise and similar taxes which Seller may be required to pay or collect with respect to the goods and/or services covered by any Order, shall be for the account of the Buyer except as otherwise provided by law or unless specifically stated otherwise by Seller in writing.

TERMINATION AND HOLD ORDERS: No Order may be terminated by Buyer except upon written request by Buyer and approval by Seller, and if said request is approved by Seller, under the following conditions: (1) Buyer agrees to accept delivery of all of the units completed by Seller through the workday on which Seller receives the written termination request; (2) Buyer agrees to pay to Seller all direct costs and expenses applicable to the portion of the Order that is incomplete.

WARRANTY:

A. Hardware: Seller warrants its goods against defects in materials and workmanship under normal use and service for one (1) year from the date of invoice.

B. Software and Firmware: Unless otherwise specified, Seller warrants for a period of one (1) year from date of invoice that standard software or firmware, when used with Seller specified hardware, shall perform in accordance with Seller's published specifications. Seller makes no representation or warranty, expressed or implied, that the operation of the software or firmware shall be uninterrupted or error-free, or that functions contained therein shall meet or satisfy the Buyer's intended use or requirements.

C. Services: Seller warrants that services, including engineering and custom application, whether provided on a fixed cost or time and material basis, shall be performed in accordance with generally accepted industry practices.

D. Remedies: Seller's liability under this section is restricted to replacing, repairing, or issuing credit (at Seller's option) for any returned goods and only under the following conditions: (1) Seller must be promptly notified, in writing, as soon as possible after the defects have been noted by the Buyer, but not later than (1) year from date of invoice from Seller; (2) The defective goods are to be returned to the place of manufacture, shipping charges prepaid by the Buyer; (3) Seller's inspection shall disclose to its satisfaction that the goods were defective in materials or workmanship at the time of shipment; (4) Any warranty service (consisting of time, travel and expenses related to such services) performed other than at Seller's factory, shall be at Buyer's expense.

E. Repaired/Reconditioned Goods: As to out-of-warranty goods which Seller has repaired or reconditioned, Seller warrants for a period of sixty (60) days from date of its invoice only new components replaced in the most recent repair/reconditioning.

F. Returns and Adjustments: No goods may be returned unless authorized in advance by Seller and then only upon such conditions to which Seller may agree. Buyer must obtain an RMA (Return Material Authorization) number from Seller prior to any return shipment and such RMA number must appear on the shipping label and packing slip. Buyer shall be responsible for the returned goods until such time as Seller receives the same at its plant and for all charges for packing, inspection, shipping, transportation, or insurance associated with returned goods. In the event that credit for returned goods is granted, it shall be at the lesser of the then current prices or the original purchase price. Claims for shortage or incorrect material must be made within five (5) days after receipt of shipment.

ALL OTHER WARRANTIES, FOR ANY OF SELLER'S GOODS OR SERVICES, WHETHER ORAL, WRITTEN, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE ARE EXCLUDED.

INTELLECTUAL PROPERTY: Seller's sale of goods or provision of related documentation or other materials to Buyer shall not transfer any intellectual property rights to Buyer unless Seller specifically agrees to do so in writing. Seller shall retain ownership of all applicable patents, trademarks, copyrights and other intellectual property rights. Buyer shall not use, copy or transfer any such items in violation of Seller's intellectual property rights or applicable law, or for any purposes other than that for which the items were furnished.

Seller shall defend any lawsuit brought against the Buyer based on a claim that the design or construction of the goods sold hereunder by Seller infringe any United States or Canadian Patent, Copyright or Mask Work Registration, provided that Buyer promptly notifies Seller of such claim in writing and further provided that, at Seller's expense, (1) Buyer gives Seller the sole right to defend or control the defense of the suit or proceeding, including settlement, and (2) Buyer provides all necessary information and assistance for that defense. In the event of a charge of infringement, Seller's obligation under the agreement shall be fulfilled if Seller, at its option and expense, either (i) settles such claim; (ii) procures for Buyer the right to continue using such goods; (iii) replaces or modifies goods to avoid infringement; or (iv) accepts the return of any infringing goods and refunds their purchase price; or (iv) defends against such claim.

If Buyer furnishes specifications or designs to Seller, the obligations of Seller set forth above shall not apply to goods made by Seller using such specifications or designs, and Buyer shall defend, indemnify and hold Seller harmless against any third party claims for infringement which arise out of Seller's use of specifications or designs furnished by Buyer.

SOFTWARE LICENSE: If goods purchased hereunder include software ("Software"), Buyer may use the Software only as part of the goods. Buyer may not use, copy, or transfer any of the Software except as may be permitted under the applicable License Agreement provided with the goods. Buyer's right to use, copy or transfer the Software shall terminate upon termination of Buyer's right to use the goods.

PACKAGING/WEIGHTS AND DIMENSIONS: Buyer specified packing or marking may be subject to additional charges not otherwise included in the price of the goods. Published weights and dimensions are estimates or approximate only and are not warranted.

FORCE MAJEURE: Seller shall not be responsible for delays in delivery or any failure to deliver due to causes beyond Seller's control, including but not limited to the following items: acts of God, war, terrorism, mobilization, civil commotion, riots, embargoes, domestic or foreign governmental regulations or orders, governmental priorities, port congestion, acts of the Buyer, its agents or employees, fires, floods, strikes, lockouts and other labor difficulties, shortages of or inability to obtain shipping space or transportation, inability to secure fuel, supplies or power at current prices or on account of shortages thereof, or due to limitations imposed by the extent of availability of Seller's normal manufacturing facilities.

If a delay excused per the above extends for more than ninety (90) days and the parties have not agreed upon a revised basis for continuing providing the goods or services at the end of the delay, including adjustment of the price, then Buyer, upon thirty (30) days' prior written notice to Seller may terminate the Order with respect to the unexecuted portion of the goods or services, whereupon Buyer shall promptly pay Seller its reasonable termination charges upon submission of Seller's invoices thereof.

LIMITATION OF LIABILITY: Seller's liability for any claim of any kind, except infringement of intellectual property rights, shall not exceed the purchase price of any goods or services which give rise to the claim. ***SELLER SHALL IN NO EVENT BE LIABLE FOR BUYER'S MANUFACTURING COSTS, LOST PROFITS, LOSS OF USE OF THE GOODS OR SERVICES, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES, SERVICES OR REPLACEMENT POWER, DOWNTIME COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR DAMAGES, OR OTHER SPECIAL, PROXIMATE, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES.*** Any action against Seller must be brought within eighteen (18) months after the cause of action accrues. These disclaimers and limitations of liability shall apply regardless of the form of action, whether in contract, tort or otherwise, and further shall extend to the benefit of Seller's vendors, appointed distributors and other authorized resellers as third-party beneficiaries.

PROHIBITION FOR HAZARDOUS USE: Goods sold hereunder generally are not intended for application in and shall not be used by Buyer in the construction or operation of a nuclear installation or in connection with the use or handling of nuclear material, or for any hazardous activity or critical application, where failure of a single component could cause substantial harm to persons or property, unless the goods have been specifically approved for such a use or application. Seller disclaims all liability for any loss or damage resulting from such unauthorized use and Buyer shall defend, indemnify and hold harmless the Seller against any such liability, whether as a result of breach of contract, warranty, tort (regardless of the degree of fault or negligence), strict liability or otherwise.

EXPORT CONTROL: Buyer shall comply with all export control laws and regulations of the United States, and all sales hereunder are subject to those laws and regulations. Seller shall not be named as shipper or exporter of record for any goods sold hereunder unless specifically agreed to in writing by Seller. At Seller's request, Buyer shall furnish Seller with end-use and end-user information to determine export license applicability. Buyer warrants, in accordance with U.S. Export Law, that goods sold hereunder shall not be destined for facilities or activities involving nuclear, chemical or biological weapons, or related missile delivery systems in named prohibited regions or countries.

GOVERNING LAW: Seller intends to comply with all laws applicable to its performance under any order. All matters relating to interpretation and effect of these terms and any authorized changes, modifications or amendments thereto shall be governed by the laws of the Commonwealth of Pennsylvania. No government contract regulations or clauses shall apply to the goods or services, this agreement, or act to bind Seller unless specifically agreed to by Seller in writing.

NON-WAIVER BY SELLER: Waiver by Seller of a breach of any of these terms and conditions shall not be construed as a waiver of any other breach.

SEVERABILITY AND ENTIRE AGREEMENT: If any provision of these terms and conditions is unenforceable, the remaining terms shall nonetheless continue in full force and effect. This writing, together with any other terms and conditions Seller specifically agrees to in writing, constitutes the entire terms and conditions of sale between Buyer and Seller and supercedes any and all prior discussions, and negotiations on its subject matter.

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DREXELBROOK
An ISO 9001 Certified Company

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